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BI-METAL FASTENER FOR THERMAL GROWTH COMPENSATION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application No. 61/786,123 filed Mar. 14, 2013, the contents of which are hereby incorporated in their entirety.

FIELD OF TECHNOLOGY

An improved fastening system for securing members together is presented, and more particularly, but not exclusively, an improved fastening system for securing ceramic matrix composite parts to a metal structure that operates in extreme temperature environments such as, but not limited to, a gas turbine engine.

BACKGROUND

Gas turbine engine combustors are subjected to and must meet stringent emission standards. This means that the wall cooling air needs to decrease to control emissions. A combustor can have an inner and outer liner and tiles can be used to line the walls of combustor to aid in thermal control and heat dissipation. Tiles can have operating temperatures in excess of 1150° C. and are desirable to use in such extreme operating conditions.

Securing tiles to a surface, such as the metal liner of a combustor, requires a fastening system that is capable of operating in extreme temperatures. Traditionally bolts or studs have been used to secure tiles to the liner. However, bolts and other traditional fasteners, expand relative to their thermal environment. When the bolts expand the thermal expansion can result in a loss of fastener preload and can result in gaps which leak available cooling air and degrade performance of the cooling system. Over a period of time the hardware heats and cools repeatedly, which subjects the fastening system to potential variances.

Several problems exist when using metal fasteners for ceramics. One such issue is that at elevated temperatures, such as in a gas turbine engine, the relative thermal growth between a metal fastener and the ceramic is so great that the joint invariably becomes loose. A common approach could be to minimize the distance over which the thermal mismatch is applied. But the problem remains and becomes an issue of magnitude of the thermal growth.

The issue of bolts becoming loose at elevated temperatures due to thermal growth remains an unresolved problem throughout the gas turbine, and many other, industries, where high temperatures and metal fasteners are combined. Thus, the problem of fasteners thermally expanding and causing gaps or loosening of surrounding parts is an ongoing concern that could cause damage to machinery that are operating under such conditions.

Loosening can be compensated by re-torquing fasteners or by installing a washer to fill the void that is created between the fastener and the structure which it secures. However, in a sealed system, such as a combustor for a gas turbine engine, it is not practical to disassemble the system to re-torque fasteners or install washers to remedy the situation. It would be desirable to provide an improved fastening system that overcomes the aforementioned problems.

BRIEF DESCRIPTION OF THE DRAWINGS

While the claims are not limited to a specific illustration, an appreciation of the various aspects is best gained through

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a discussion of various examples thereof. Referring now to the drawings, exemplary illustrations are shown in detail. Although the drawings represent the illustrations, the drawings are not necessarily to scale and certain features may be exaggerated to better illustrate and explain an innovative aspect of an example. Further, the exemplary illustrations described herein are not intended to be exhaustive or otherwise limiting or restricted to the precise form and configuration shown in the drawings and disclosed in the following detailed description. Exemplary illustrations are described in detail by referring to the drawings as follows:

FIG. 1 illustrates a schematic view of a gas turbine engine employing the improvements discussed herein;

FIG. 2 illustrates a combustor for a gas turbine engine employing an exemplary bi-metal fastener system that is shown securing a tile to a combustor liner;

FIG. 3 illustrates an enlarged side cross sectional view of the exemplary bi-metal fastening system of FIG. 2, showing three materials of dissimilar thermal growth coefficients arranged in a tight attachment; and

FIG. 4 illustrates an enlarged side cross sectional view of an alternative bi-metal fastening system that could be used in the FIG. 2 environment.

DETAILED DESCRIPTION

An exemplary embodiment discloses an improved fastening system and method that overcomes traditional thermal mismatch that occurs with standard fastener systems that are employed in extreme temperature environments. The fastening system could employ a metallic fastener that is combined with metallic spacer, each of which having a differing thermal growth coefficient. This arrangement may reduce the mismatch in relative thermal expansion by several orders of magnitude over the range of temperatures where the thermal fastener can be applied.

FIG. 1 illustrates a gas turbine engine 10, which includes a fan 12, a low pressure compressor and a high pressure compressor, 14 and 16, a combustor 18, and a high pressure turbine and low pressure turbine, 20 and 22, respectively. The high pressure compressor 16 is connected to a first rotor shaft 24 while the low pressure compressor 14 is connected to a second rotor shaft 26. The shafts extend axially and are parallel to a longitudinal center line axis 28.

Ambient air 30 enters the fan 12 and is directed across a fan rotor 32 in an annular duct 34, which in part is circumscribed by fan case 36. The bypass airflow 38 provides engine thrust while the primary gas stream 40 is directed to the combustor 18 and the high pressure turbine 20. The gas turbine engine 10 includes an improved combustor 18 having a bi-metal fastener assembly 42 for improved thermal growth compensation. It will be appreciated that the bi-metal fastener assembly 42 for improved thermal growth compensation could be used in other machinery and is not therefor limited to gas turbine engine environments.

FIG. 2 illustrates one example of an improved bi-metal fastener assembly 42 being used in a combustor 18 of a gas turbine engine 10. The combustor 18 has an outer liner 44 and an inner liner 46 made of metal. Attached to the liners 44, 46 are ceramic tiles 48 that are secured by the novel bi-metal fastener assembly 42. It will be appreciated that the bi-metal fastener assembly 42 may be used in other applications apart from gas turbine engines.